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Practitioner's Docket No. 97-904CIP1 *PATENT*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor: Richard H. Warren

For (title): METHOD AND SYSTEM FOR PREVENTING SUN TRANSIT OUTAGES IN POINT-TO-MULTIPOINT SATELLITE SYSTEMS

1. Type of Application

This transmittal is for a continuation-in-part (C-I-P) application.

2. Benefit of Prior U.S. Application (35 U.S.C. 119(e), 120, or 121)

CERTIFICATION UNDER 37 C.F.R. 1.10*
*(Express Mail label number is **mandatory**.)*
(Express Mail certification is optional.)

I hereby certify that this correspondence and the documents referred to as attached therein are being deposited with the United States Postal Service on this date 12/18/98, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EE223332222US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Mary E. Anza
(type or print name of person mailing paper)

Mary E. Anza
Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

***WARNING:** *Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

The new application being transmitted claims the benefit of prior U.S. application 08/988,989, filed 12/11/97.

3. Papers Enclosed

A. Required for filing date under 37 C.F.R. 1.53(b) (Regular) or 37 C.F.R. 1.153 (Design) Application

9 Page(s) of Specification
3 Page(s) of Claims
8 Sheet(s) of Drawing(s)-Formal

B. Other Papers Enclosed

1 Page(s) of Abstract
Page(s) of ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

4. Additional Papers Enclosed

☒ Information Disclosure Statement (37 CFR 1.98)
☒ Form PTO-1449 (PTO/SB/08A and 08B)
☒ Citations

5. Declaration or Oath

x Enclosed

Executed by:

6. Inventorship Statement

The inventorship for all the claims in this application is the same.

7. Language

English

8. Fee Calculation (37 C.F.R. 1.16)

Regular Application

CLAIMS AS FILED					
Claims	Number Filed	Basic Fee Allowance	Number Extra	Rate	Basic Fee 37 CFR 1.16(a) $760.00
Total Claims (37 CFR 1.16(c))	8	- 20 =	0 x	$18.00	$0.00
Independent Claims (37 CFR 1.16(b))	6	- 3 =	3 x	$78.00	$234.00
Multiple Dependent Claim(s), if any (37 CFR 1.16(d))			+	$260.00	
		Filing Fee Calculation			$994.00

9. Fee Payment Being Made at This Time

Enclosed

Filing Fee	$994.00	Basic Filing Fee
Total Fees Enclosed	$994.00	Fee Payment Total Fees Enclosed

10. Method of Payment of Fees

Charge Account No. 72339 in the amount of $994.00 Method of Payment.
A duplicate of this transmittal is attached.

11. Authorization to Charge Additional Fees

The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 72339.

☒ 37 C.F.R. 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. 1.16(b), (c) or (d) (presentation of extra claims)

12. Instructions as to Overpayment

Credit Account No. 72339.

ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED

13. Relate Back

14. Maintenance of Copendency of Prior Application

15. Further Inventorship Statement Where Benefit of Prior Application(s) Claimed

Floyd E. Anderson

SIGNATURE OF PRACTITIONER

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Practitioner's Docket No. 97-904CIP1 ***PATENT***

ADDED PAGES FOR APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED

NOTE: See 37 CFR 1.78.

17. Relate Back

WARNING: If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.

(complete the following, if applicable)

[ ] Amend the specification by inserting, before the first line, the following sentence:

A. 35 U.S.C. 119(e)

NOTE: "Any nonprovisional application claiming the benefit of one or more prior filed copending provisional applications must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior provisional application, identifying it as a provisional application, and including the provisional application number (consisting of series code and serial number)." 37 C.F.R. § 1.78(a)(4).

[ ] "This application claims the benefit of U.S. Provisional Application(s) No(s).:

APPLICATION NO(S).:	**FILING DATE**
_____/_____	_____"
_____/_____	_____"
_____/_____	_____"

B. 35 U.S.C. 120, 121 and 365(c)

NOTE: "Except for a continued prosecution application filed under § 1.53(d), any nonprovisional application claiming the benefit of one or more prior filed copending nonprovisional applications or international applications designating the United States of America must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior application, identifying it by application number (consisting of the series code and serial number) or international application number and international filing date and indicating the relationship of the applications. . . . Cross-references to other related applications may be made when appropriate." (See § 1.14(a)). 37 C.F.R. § 1.78(a)(2).

[X] "This application is a

[ ] continuation

[X] continuation-in-part

[ ] divisional

of copending application(s)

[X] application number 08 / 988,989 filed on 12/11/97 "

[ ] International Application _____ filed on _____ and which designated the U.S."

NOTE: The proper reference to a prior filed PCT application that entered the U.S. national phase is the U.S. serial number and the filing date of the PCT application that designated the U.S.

NOTE: (1) Where the application being transmitted adds subject matter to the International Application, then the filing can be as a continuation-in-part or (2) if it is desired to do so for other reasons then the filing can be as a continuation.

NOTE: The deadline for entering the national phase in the U.S. for an international application was clarified in the Notice of April 28, 1987 (1079 O.G. 32 to 46) as follows:

"The Patent and Trademark Office considers the International application to be pending until the 22nd month from the priority date if the United States has been designated and no Demand for International Preliminary Examination has been filed prior to the expiration of the 19th month from the priority date and until the 32nd month from the priority date if a Demand for International Preliminary Examination which elected the United States of America has been filed prior to the expiration of the 19th month from the priority date, provided that a copy of the international application has been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively. If a copy of the international application has not been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively, the international application becomes abandoned as to the United States 20 or 30 months from the priority date respectively. These periods have been placed in the rules as paragraph (h) of § 1.494 and paragraph (i) of § 1.495. A continuing application under 35 U.S.C. 365(c) and 120 may be filed anytime during the pendency of the international application."

[ ] "The nonprovisional application designated above, namely application _____ /_____, filed _____, claims the benefit of U.S. Provisional Application(s) No(s).:

APPLICATION NO(S).:	**FILING DATE**
_____ /_____	_____ "
_____ /_____	_____ "
_____ /_____	_____ "

[ ] Where more than one reference is made above please combine all references into one sentence.

18. Relate Back—35 U.S.C. 119 Priority Claim for Prior Application

The prior U.S. application(s), including any prior International Application designating the U.S., identified above in item 17B, in turn itself claim(s) foreign priority(ies) as follows:

Country	Appln. no.	Filed

The certified copy(ies) has (have)

[ ] been filed on _____, in prior application 0 /_____, which was filed on _____.

[ ] is (are) attached.

WARNING: The certified copy of the priority application that may have been communicated to the PTO by the International Bureau may not be relied on without any need to file a certified copy of the priority application in the continuing application. This is so because the certified copy of the priority application communicated by the International Bureau is placed in a folder and is not assigned a U.S. serial number unless the national stage is entered. Such folders are disposed of if the national stage is not entered. Therefore, such certified copies may not be available if needed later in the prosecution of a continuing application. An alternative would be to physically remove the priority documents from the folders and transfer them to the continuing application. The resources required to request transfer, retrieve the folders, make suitable record notations, transfer the certified copies, enter and make a record of such copies in the Continuing Application are substantial. Accordingly, the priority documents in folders of international applications that have not entered the national stage may not be relied on. Notice of April 28, 1987 (1079 O.G. 32 to 46).

19. Maintenance of Copendency of Prior Application

NOTE: The PTO finds it useful if a copy of the petition filed in the prior application extending the term for response is filed with the papers constituting the filing of the continuation application. Notice of November 5, 1985 (1060 O.G. 27).

A. [ ] Extension of time in prior application

*(This item **must** be completed and the papers filed **in the prior application,** if the period set in the prior application has run.)*

[ ] A petition, fee and response extends the term in the pending **prior** application until _____

[ ] A **copy** of the petition filed in prior application is attached.

B. [ ] Conditional Petition for Extension of Time in Prior Application

(complete this item, if previous item not applicable)

[ ] A conditional petition for extension of time is being filed in the pending **prior** application.

[ ] **A copy** of the conditional petition filed in the prior application is attached.

20. Further Inventorship Statement Where Benefit of Prior Application(s) Claimed

(complete applicable item (a), (b) and/or (c) below)

(a) [ ] This application discloses and claims only subject matter disclosed in the prior application whose particulars are set out above and the inventor(s) in this application are

[ ] the same.

[ ] less than those named in the prior application. It is requested that the following inventor(s) identified for the prior application be deleted:

_____

(type name(s) of inventor(s) to be deleted)

(b) [x] This application discloses and claims additional disclosure by amendment and a new declaration or oath is being filed. With respect to the prior application, the inventor(s) in this application are

[x] the same.

[ ] the following additional inventor(s) have been added:

_____

(type name(s) of inventor(s) to be deleted)

(c) [x] The inventorship for all the claims in this application are

[x] the same.

[ ] not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made

[ ] is submitted.

[ ] will be submitted.

21. Abandonment of Prior Application *(if applicable)*

[ ] Please abandon the prior application at a time while the prior application is pending, or when the petition for extension of time or to revive in that application is granted, and when this application is granted a filing date, so as to make this application copending with said prior application.

NOTE: According to the Notice of May 13, 1983 (103, TMOG 6-7), the filing of a continuation or continuation-in- part application is a proper response with respect to a petition for extension of time or a petition to revive and should include the express abandonment of the prior application conditioned upon the granting of the petition and the granting of a filing

date to the continuing application.

22. Petition for Suspension of Prosecution for the Time Necessary to File an Amendment

WARNING: *"The claims of a new application may be finally rejected in the first Office action in those situations where (1) the new application is a continuing application of, or a substitute for, an earlier application, and (2) all the claims of the new application (a) are drawn to the same invention claimed in the earlier application, and (b) would have been properly finally rejected on the grounds of art of record in the next Office action if they had been entered in the earlier application." MPEP, § 706.07(b).*

NOTE: *Where it is possible that the claims on file will give rise to a first action final for this continuation application and for some reason an amendment cannot be filed promptly (e.g., experimental data is being gathered) it may be desirable to file a petition for suspension of prosecution for the time necessary.*

(check the next item, if applicable)

[ ] There is provided herewith a Petition To Suspend Prosecution for the Time Necessary to File An Amendment (New Application Filed Concurrently)

23. Small Entity (37 CFR § 1.28(a))

[ ] Applicant has established small entity status by the filing of a statement in parent application /_____ on _____.

[ ] A copy of the statement previously filed is included.

WARNING: *See 37 CFR § 1.28(a).*

24. NOTIFICATION IN PARENT APPLICATION OF THIS FILING

[x] A notification of the filing of this
(check one of the following)

[ ] continuation

[x] continuation-in-part

[ ] divisional

is being filed in the parent application, from which this application claims priority under 35 U.S.C. § 120.

EXPRESS MAIL EE223332222US

Attorney Docket No. 97-904CIP1

UNITED STATES PATENT APPLICATION

OF

Richard H. Warren

FOR

METHOD AND SYSTEM FOR PREVENTING SUN TRANSIT OUTAGES IN POINT-TO-MULTIPOINT SATELLITE SYSTEMS

METHOD AND SYSTEM FOR PREVENTING SUN TRANSIT OUTAGES IN POINT-TO-MULTIPOINT SATELLITE SYSTEMS

Related Applications

This application is a continuation-in-part of application Serial Number 08/988,989, filed 12/11/97 ,which is hereby incorporated in its entirety by reference.

Field of the Invention

The present invention relates to geostationary satellite communication antenna. In particular, it relates to small diameter C-band geostationary satellite antenna.

Background of the Invention

Fig. 1 shows a geostationary communication satellite system 100 comprising a plurality of satellites 102_1 to 102_i orbiting the earth 104. Satellite 102_1 is separated from adjacent satellites 102_2 and 102_3 by approximately a 2° arc (the arc is shown by the separation between the dashed lines on each of Figs. 1, 2, 5, and 6, and is typical for geostationary satellites in the United States). Earth 104 has a plurality of earth stations 106_1 to 106_n. Each earth station 106 includes a satellite transmitting and receiving antenna 108. Communication system 100 operates when antenna 108 generates a communication signal 110 that is received by, for example, satellite 102_1, and visa versa.

As communication signal 110 travels from, for example, earth station 106_1 to its intended destination at satellite 102_1 it spreads over an area 112. If communication signal 110 spreads beyond the 2° arc between satellite 102_1 and the adjacent satellites 102_2 and 102_3, then all three satellites 102_1, 102_2, and 102_3 would process communication signal 110 as if it was intended for them. One reason this occurs is that communication signal 110 does not experience significant signal attenuation at the edge of area 112. In order to prevent satellites 102_2 and 102_3 from processing communication signal 110, antenna 108 generates a narrow beam communication signal, instead of a wide beam communication signal.

The most widely used radio frequency bands for satellite communication are the Ku- and C-bands. In both of these bands, a conventional parabolic reflector antenna generates a narrow communication signal to prevent adjacent satellites from processing communication signals not intended for them. The parabolic reflector antenna for the Ku-band may have a relatively small diameter. The small parabolic reflector antenna provides an efficient, cost-effective mechanism for allowing an earth station to communicate with an individual satellite. Unfortunately, Ku-band radio signals attenuate in atmospheric conditions consistent with periods of moderate-to-heavy precipitation, i.e., rain, sleet, or snow. In most cases, providing facilities with sufficient power to compensate for severe signal attenuation is uneconomical. As a result, satellite communications systems operating in the Ku-band experience periodic system outages that are unacceptable for time critical applications.

To avoid periodic system outages due to atmospheric conditions, earth stations typically transmit and receive data using C-band radio frequencies. These frequencies are much less susceptible to attenuation due to precipitation. Therefore, C-band transmitters can economically provide sufficient signal margin to overcome any signal attenuation due to atmospheric conditions. Unfortunately, to generate narrow communication signal beams, C-band parabolic antennas need to be larger than Ku-band antennas. In fact, the minimum C-band parabolic antenna diameter that prevents communication signal 110 from interfering with satellites 102_2 or 102_3 (*See* Fig. 1) is approximately 3.7 meters. For many applications, however, the installation of a 3.7 meter diameter antenna is too unwieldy, aesthetically unseemly, and/or not structurally prudent. Therefore, it would be desirable to use smaller diameter parabolic reflective antenna to transmit C-band radio frequencies while avoiding unnecessary interference with adjacent satellites.

Further, during short periods of each day for several days immediately before and after the vernal and autumnal equinoxes, the sun transits behind geostationary satellites as seen from an earth station's receiving antenna (i.e.,

from the perspective of the earth station, the sun passes behind the geostationary satellite). The sun emits a great deal of energy in the form of electromagnetic radiation in the bandwidth occupied by radio wave communications. Therefore, when the sun is located within the beamwidth of the receiving antenna, its energy causes interference in the form of radio frequency noise. This noise causes a decrease in the signal-to-noise ratio of the earth station's receiver, and can render the earth station inoperative until the sun completes its transit of the antenna's beamwidth.

Because the relative movement of the earth with respect to the sun is known to a high degree of precision, satellite communication system operators are forewarned of the time when the sun will transit the beamwidth of a receiving antenna. Knowledge of a pending problem, however, is only useful if the system operators can keep the system operational during these periods.

For conventional satellite systems, each individual receive antenna might be effected by the sun's positioning during this period. Some conventional systems use costly terrestrial communications facilities to provide continuing operations as the sun transits behind a satellite with respect to its earth station's receiving antenna. Other systems remain off-the-air for the duration of these periods. The inherent inconvenience of this option, however, renders it particularly unattractive. Finally, some conventional satellite systems continue operation by switching each earth station's antenna to a secondary satellite during the period that the sun is within the beamwidth of the antenna. This process requires manual intervention and/or complex automated mechanical mechanisms to perform the daily repositioning of the antenna during its sun transit outage. The cost of the daily repositioning of each antenna so effected renders this option uneconomical.

Therefore, a need exists for a satellite communication system to efficiently provide communication during sun transit outages.

Summary of the Invention

Systems and methods consistent with the present invention address

this need by providing a mechanism for repositioning an earth station's antenna during a sun transit outage. Alternatively systems and methods consistent with the present invention provide a second antenna at the earth station directed toward a second satellite.

In accordance with the purpose of the invention, as embodied and broadly described herein, a point-to-multipoint satellite communication system, comprises a first satellite antenna for generating a wide beam communication signal to illuminate a plurality of satellite, means for generating a return communication signal from each of the plurality of satellites, a second satellite antenna for receiving the return communication signal from only one of the plurality of satellites, and a satellite antenna repositioning system for repositioning said second antenna when the sun transits within the beamwidth of said second antenna.

Both the foregoing general description and the following detailed description are exemplary and explanatory, and are intended to provide further explanation of the invention as claimed.

Brief Description of the Drawings

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate preferred embodiments of the invention and, together with the description, explain the goals and principles of the invention. In the drawings,

Fig. 1 is an illustration of a geostationary satellite communication system;

Fig. 2 is an illustration of a geostationary satellite communication system consistent with the present invention;

Fig. 3 is a flow chart illustrating the reception operation of the communication system of Fig. 2;

Fig. 4 is a flow chart illustrating the transmission operation of the communication system of Fig. 2;

Fig. 5 is an illustration of a second geostationary satellite communication system consistent with the present invention;

Fig. 6 is an illustration of a third geostationary satellite communication

system consistent with the present invention;

Fig. 7 is an illustration of a fourth geostationary satellite communication system consistent with the present invention; and

Fig. 8 is an illustration of a fifth geostationary satellite communication system consistent with the present invention.

Description of the Preferred Embodiment

The following detailed description of the invention refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Also, the following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.

Systems and methods consistent with the present invention provide efficient and continuous communications during sun transit outages by providing a secondary channel for communications to continue during the outages.

Communication systems consistent with the present invention comprise a "hub and spoke" configuration. In this configuration, a central earth station acts as the hub and a plurality of earth stations act as the spokes. Communication from the central earth station to any one of the plurality of earth stations is direct in that it involves a single transmission to the satellite and a single transmission from the satellite. Communication between spokes, however, is not direct. A transmitting earth station communicates with the central earth station, which retransmits the signal to a receiving earth station. In this case, there are two transmissions to a satellite and two transmissions from a satellite.

Fig. 2 is a diagram of satellite communication system 200 that uses a relatively small diameter C-band antenna (also called a very small aperture terminal (VSAT) antenna) for the transmission and reception of communication signals. System 200 includes a plurality of satellites 202_1 to 202_n, a central earth station 204, and a plurality of earth stations 206_1 to 206_n. Central earth station 204 transmits to the plurality of satellites 202 via a

communication signal 208. Each of the earth stations 206 transmits to the plurality of satellites 202 via a communication signal 210. Each of the satellites 202 communicates with central earth station 204 and the plurality of earth stations 206 with a return communication signal (not shown).

Central earth station 204 includes a relatively large C-band antenna 214 having a relatively narrow beamwidth. Conversely, each of the plurality of earth stations 206 includes a relatively small C-band antenna 216 having a relatively wide beamwidth.

Fig. 3 is a flow chart 300 of a return communication from one of the satellites 202 to antenna 216. First, central earth station 204 aligns its narrow beam antenna 214 to illuminate a single satellite 202, for example satellite 202_1 (step 302). Next, antenna 214 generates a narrow communication signal 208 (step 304), which is received solely by satellite 202_1 (step 306). Based on communication signal 208, satellite 202_1 broadcasts a return communication signal (step 308). Antenna 216 receives the return communication signal (step 310).

Fig. 4 is a flow chart 400 illustrating the transmission of a communication signal 210 from antenna 216 to the plurality of satellites 202. First, one of the earth stations 206 aligns its antenna 216 to illuminate satellite 202_1 (step 402). Next, antenna 216 generates a relatively wide communication signal 210 (step 404), which is received by satellite 202_1, along with the other satellites within the gain pattern of signal 210, such as satellites 202_2 and 202_3 (step 406). In response to communication signal 210, each of the satellites broadcasts return communication signals (step 408). Due to its narrow beamwidth, however, antenna 214 receives the return communication signal from the single satellite at which it is pointed (i.e., satellite 202_1).

During transmission from antenna 216, both satellites 202_2 and 202_3 receive communication signal 210. Due to its wide beamwidth, antenna 216 receives return communication signals from all three satellites 202_1, 202_2 and 202_3, though it is pointed only towards satellite 202_1. In the above example, when antenna 216 is aligned with satellite 202_1, it can receive return

communication signals from each of satellites 202_1, 202_2 , and 202_3.

If an antenna outside communication system 200 mistakenly illuminates a satellite within system 200, the received signal is seen by system 200 as an interference signal ("interference signal" is defined as a communication signal generated by an antenna outside a communication system that operates on the same frequency band). The illuminated satellite retransmits the signal to antenna 216, because the satellite does not distinguish the source of the signal.

Similarly, when antenna 216 illuminates satellites 202_1, 202_2, and 202_3 with communication signal 210, each of satellites 202_1, 202_2, and 202_3 transmits a return communication signal. An antenna outside of communication system 200 that is aligned with one of the satellites would receive the return communication signal. In order to avoid these types of interference, it is preferable to obtain exclusive use, on satellites 202_1, 202_2, and 202_3, of the particular frequencies that communication system 200 will use.

Although the disclosure is directed to a communication system with a central and two adjacent satellites, virtually any number of satellite configurations are possible. For example, Fig. 5 shows a communication system 500 that uses two satellites 502_1, and 502_2. Fig. 6 shows a communication system 600 that uses five satellites 602_1, 602_2 , 602_3, 602_4, and 602_5 . Communication systems 500 and 600 both operate in a manner similar to system 200 described above.

As noted above, it is preferable to exclude other satellite communication systems from using the bandwidth employed by communication system 200. However, it is not possible to control the frequencies emitted by the sun as it transits behind satellites 202 with respect to the earth. Large C-band antennas, such as antenna 214, are particularly sensitive to the noise signal emitted by the sun. This sensitivity is caused by the amplification of the sun signal received within the narrow beamwidth of the large antenna. Smaller VSAT antennas 216 do not receive as large a noise signal due to the lower level of amplification of the signal received

within their wide beamwidth.

Sun transit outage is of particular concern to operators of large point-to-multipoint (hub and spoke) satellite systems as described herein. In these hub and spoke type networks, such as system 200, all communications necessarily pass through hub antenna 214 of central earth station 204. During the transit of the sun through the beamwidth of antenna 214, the entire system becomes inoperative.

Fig. 7 is a diagram of a satellite communication system 700 that includes a satellite antenna repositioning system 720 to overcome the problem of sun transit outages. Because relatively small C-band antenna 216, or VSAT antenna, has a relatively wide beamwidth, antenna 216 communicates with several satellites, including, for example, satellites 202_1, 202_2, and 202_3. Upon receiving a signal 210 from antenna 216, each of satellites 202_1, 202_2, and 202_3 broadcasts a return communication signal. During the period that the sun passes through the beamwidth of antenna 214 (i.e., behind satellite 202_1), satellite antenna repositioning system 720 repositions antenna 214 to point to one of the proximate secondary satellites 202_2 or 202_3. As noted above, due to the relatively wide beamwidth of antennas 216, they remain in operation while the sun transits their beamwidths. Following the repositioning, therefore, antenna 214 can both transmit signals to and receive signals from antennas 216.

Fig. 8 is a diagram of a satellite communication system 800, which includes a second relatively large C-band antenna 814 installed at the central earth station 204. Station 204 directs antenna 214 at satellite 202_1, and antenna 814 at one of the proximate secondary satellites 202_2 or 202_3. During the period of transit of the sun behind satellite 202_1 with respect to antenna 214, central earth station 204 discontinues use of antenna 214 and switches to antenna 814. The operation of switching from one antenna to another is performed by an antenna switch selector (not shown). Once again, because of the relatively wide beamwidth of antenna 216, the sun does not have as large an effect on the signal-to-noise ratio of the received signal as the sun transits within the beamwidths of antennas 216. The relatively wide

beamwidths of antennas 216 also results in the illumination of satellites 202_1, and proximate secondary satellites 202_2, and 202_3. The communication link between antenna 216 and central earth station 204 is thereby maintained during the sun transit of the beamwidth of satellite 202_1 by receiving the signal from a proximate secondary satellite using antenna 814.

It will be apparent to those skilled in the art that various modifications and variations can be made in the methods and apparatus consistent with the present invention without departing from the scope or spirit of the invention. Other modification will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The specification and examples should be considered as exemplary only, with the true scope and spirit of the invention being indicated by the following claims.

What is Claimed is:

1. A point-to-multipoint satellite communication system, comprising:

a first satellite antenna for generating a wide beam communication signal to illuminate a plurality of satellites;

means for generating a return communication signal from each of the plurality of satellites;

a second satellite antenna for receiving the return communication signal from only one of the plurality of satellites; and

a satellite antenna repositioning system for repositioning said second antenna when the sun transits within the beamwidth of said second antenna.

2. The system of claim 1, wherein a diameter of the second satellite antenna is greater than a diameter of the first satellite antenna.

3. A point-to-multipoint satellite communication system, comprising:

a first satellite antenna for generating a wide beam communication signal to illuminate a plurality of satellites;

means for generating a return communication signal from each of the plurality of satellites;

a second satellite antenna, directed to a first one of the plurality of satellites, for receiving said return communication signal from said first satellite; and

a third satellite antenna, directed to a second one of the plurality of satellites located proximate to said first satellite, for receiving said return communication signal from said second satellite only during sun transit outages of said second antenna.

4. The system of claim 3, wherein diameters of the second and third satellite antennas are greater than a diameter of the first satellite antenna.

5. A method of performing satellite communication in a point-to-multipoint communications system, comprising the steps of:

aligning a first satellite antenna to illuminate a plurality of satellites;

transmitting a communication signal from the first satellite antenna to said plurality of satellites;

broadcasting a return signal from each of said plurality of satellites based on the communication signal;

aligning a second satellite antenna to receive the return signal from only a first one of the plurality of satellites;

repositioning said second satellite antenna to receive the return signal from only a second of the plurality of satellites during periods when the sun transits behind said first satellite; and

receiving the return signal from said second satellite at said second satellite antenna during said periods.

6. A method of performing satellite communication in a point-to-multipoint communications system, comprising the steps of:

aligning a first antenna to illuminate a plurality of satellites;

transmitting a communication signal from said first antenna to the plurality of satellites;

broadcasting a return signal from each of the plurality of satellites in response to the communication signal;

aligning a second antenna to receive the return signal from a first one of the plurality of satellites;

receiving the return signal from said first satellite at said second antenna when the sun is outside the beamwidth of said second antenna;

aligning a third antenna to receive the return signal from a second one of the plurality of satellites; and

receiving the return signal from said second satellite with said third antenna when the sun is within the beamwidth of said first satellite.

7. An earth station for use in a point-to-multipoint communication

system including a small satellite antenna for transmitting a wide beam communication signal and a plurality of adjacent geostationary satellites for retransmitting the communication signal from the small satellite antenna, the earth station comprising:

a large satellite antenna;

a receiver for receiving communication signals from one of the plurality of adjacent geostationary satellites; and

a satellite antenna repositioning system for repositioning the satellite antenna during a period of sun transit outage.

8. An earth station for use in a point-to-multipoint communication system including a small satellite antenna for transmitting a wide beam communication signal and a plurality of adjacent geostationary satellites for retransmitting the communication signal from the small satellite antenna, the earth station comprising:

a first large satellite antenna directed to a first one of the plurality of adjacent geostationary satellites;

a second large satellite antenna directed to a second one of the plurality of adjacent geostationary satellites; and

a receiver for receiving communication signals at one of said first and second antennas, said receiver including an antenna switch selector for selectively activating said first and said antennas, the selector activating the second antenna during periods when the sun transits within a beamwidth of said first antenna.

Abstract

A geostationary communication satellite system that uses a hub and spoke configuration, where the hub includes at least one relatively large diameter satellite antenna. The hub of the communication system is capable of receiving satellite communication signals even when the sun transits within the beamwidth of its primary antenna by either redirecting its primary antenna toward a secondary satellite, or switching to a secondary antenna directed toward a secondary satellite.

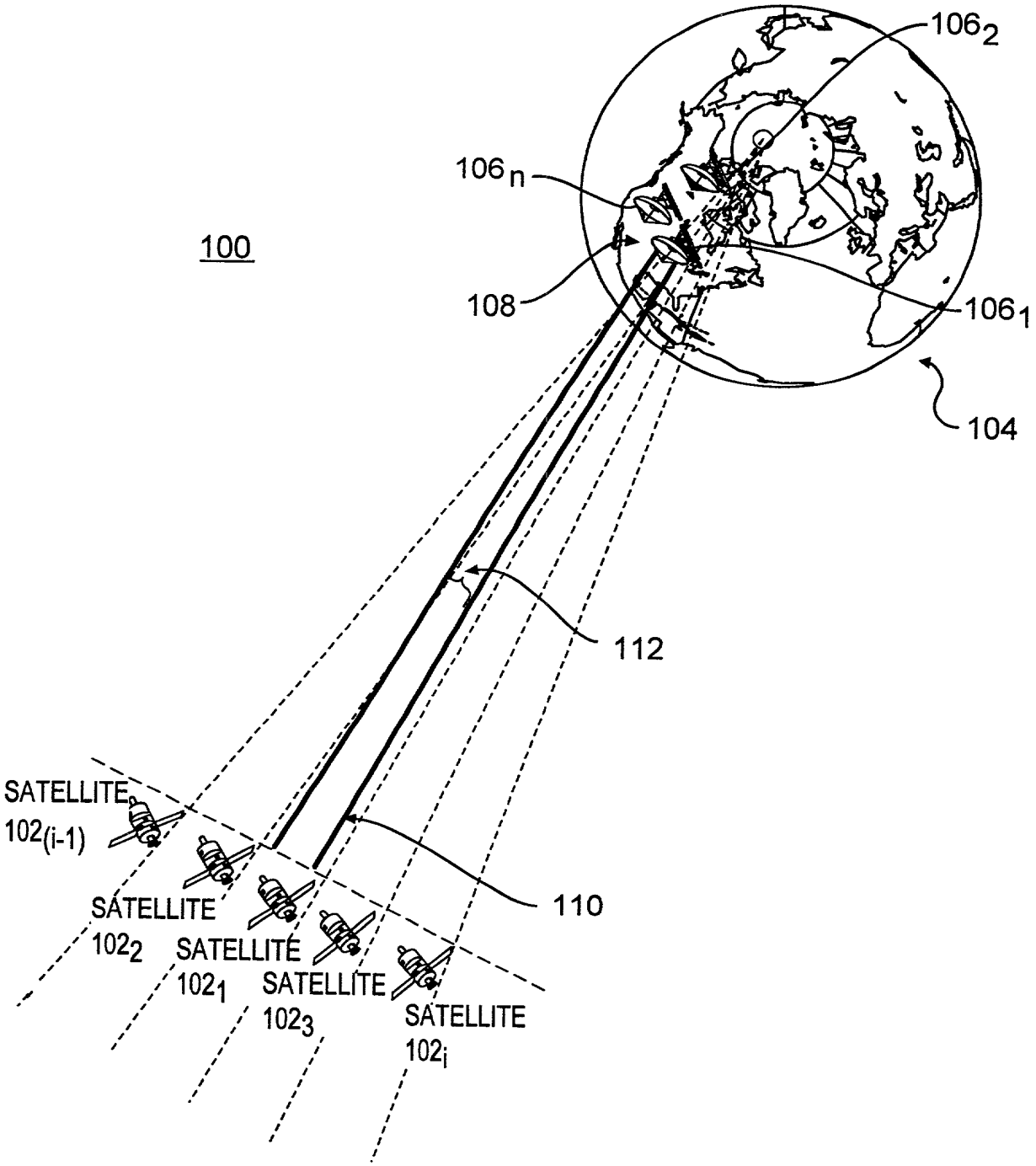
100
106_2
106_n
108
106_1
104
112
110
SATELLITE $102_{(i-1)}$
SATELLITE 102_2
SATELLITE 102_1
SATELLITE 102_3
SATELLITE 102_i

FIG. 1

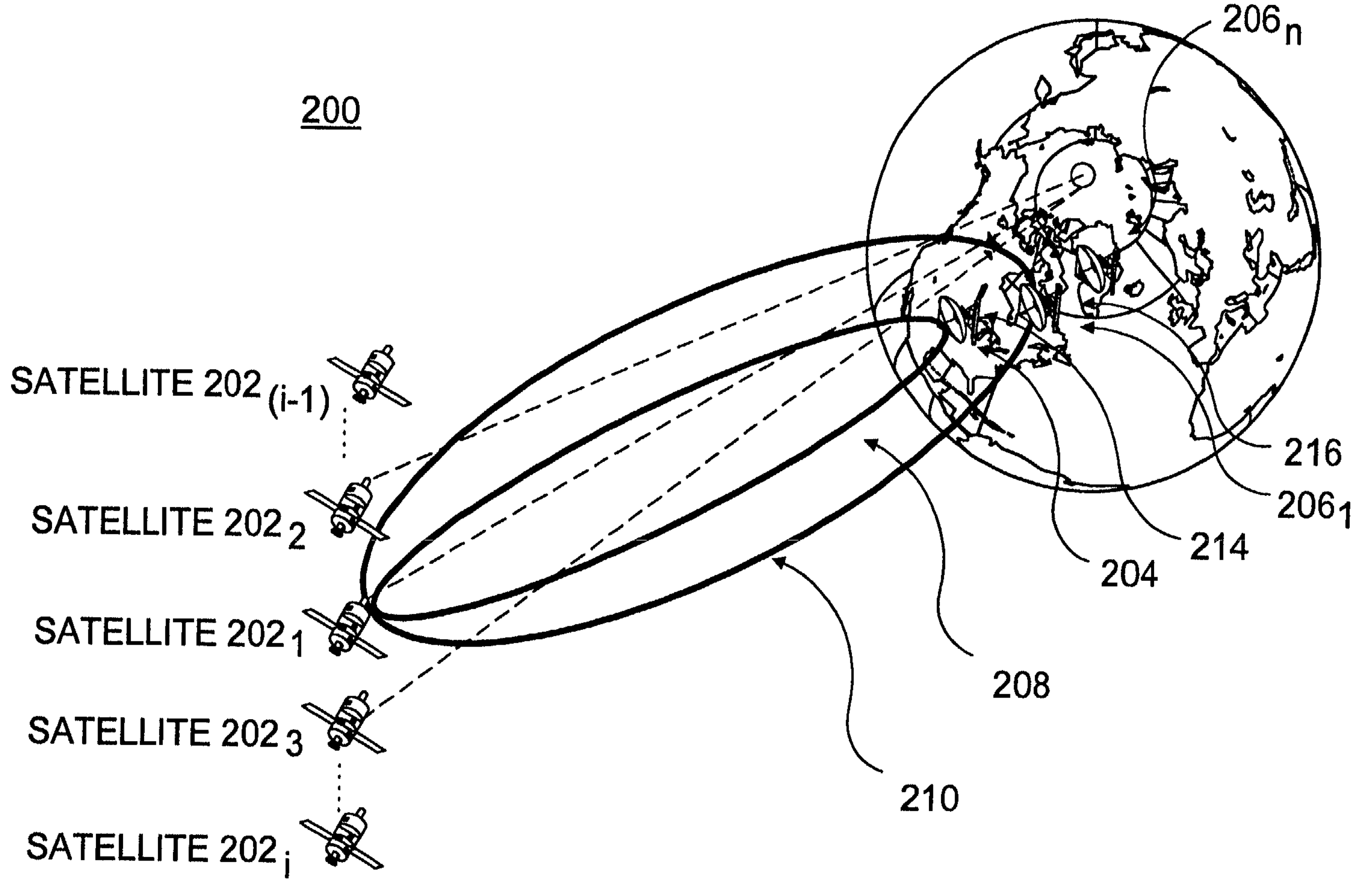
200
206n
SATELLITE 202(i-1)
SATELLITE 202 2
SATELLITE 202 1
SATELLITE 202 3
SATELLITE 202 i
216
2061
214
204
208
210

FIG. 2

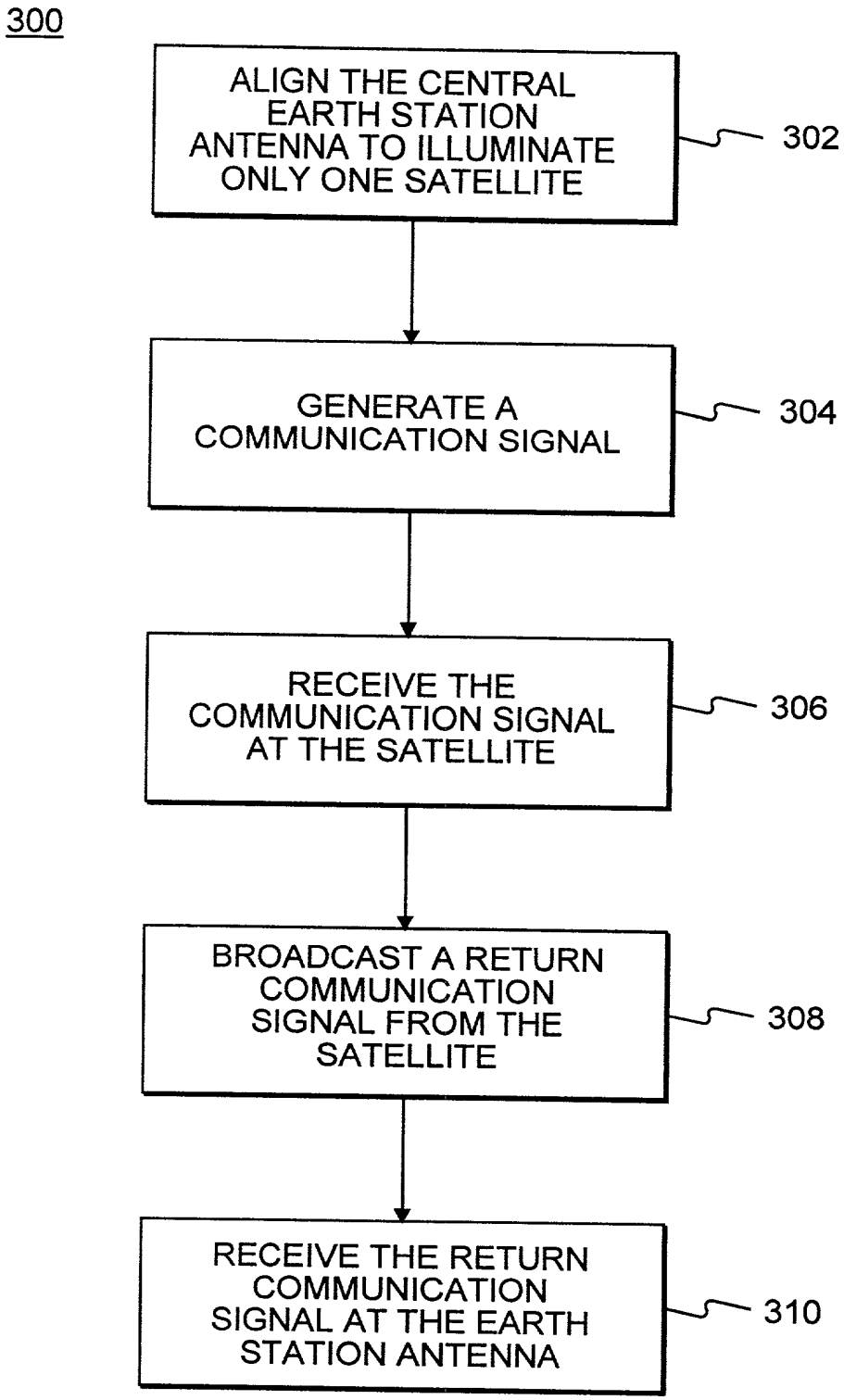
300
ALIGN THE CENTRAL EARTH STATION ANTENNA TO ILLUMINATE ONLY ONE SATELLITE
302
GENERATE A COMMUNICATION SIGNAL
304
RECEIVE THE COMMUNICATION SIGNAL AT THE SATELLITE
306
BROADCAST A RETURN COMMUNICATION SIGNAL FROM THE SATELLITE
308
RECEIVE THE RETURN COMMUNICATION SIGNAL AT THE EARTH STATION ANTENNA
310

FIG. 3

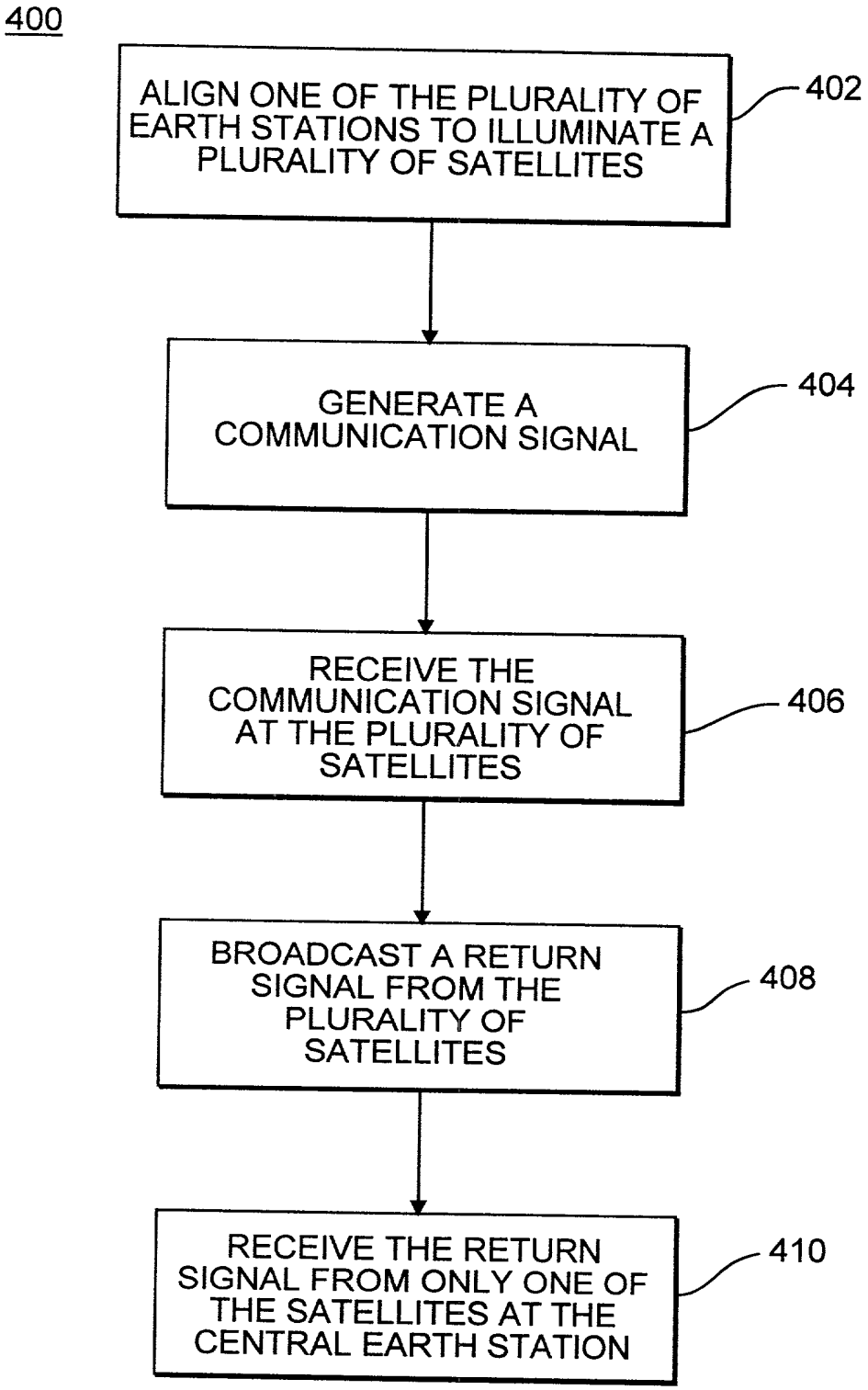
400
ALIGN ONE OF THE PLURALITY OF EARTH STATIONS TO ILLUMINATE A PLURALITY OF SATELLITES
402
GENERATE A COMMUNICATION SIGNAL
404
RECEIVE THE COMMUNICATION SIGNAL AT THE PLURALITY OF SATELLITES
406
BROADCAST A RETURN SIGNAL FROM THE PLURALITY OF SATELLITES
408
RECEIVE THE RETURN SIGNAL FROM ONLY ONE OF THE SATELLITES AT THE CENTRAL EARTH STATION
410

FIG. 4

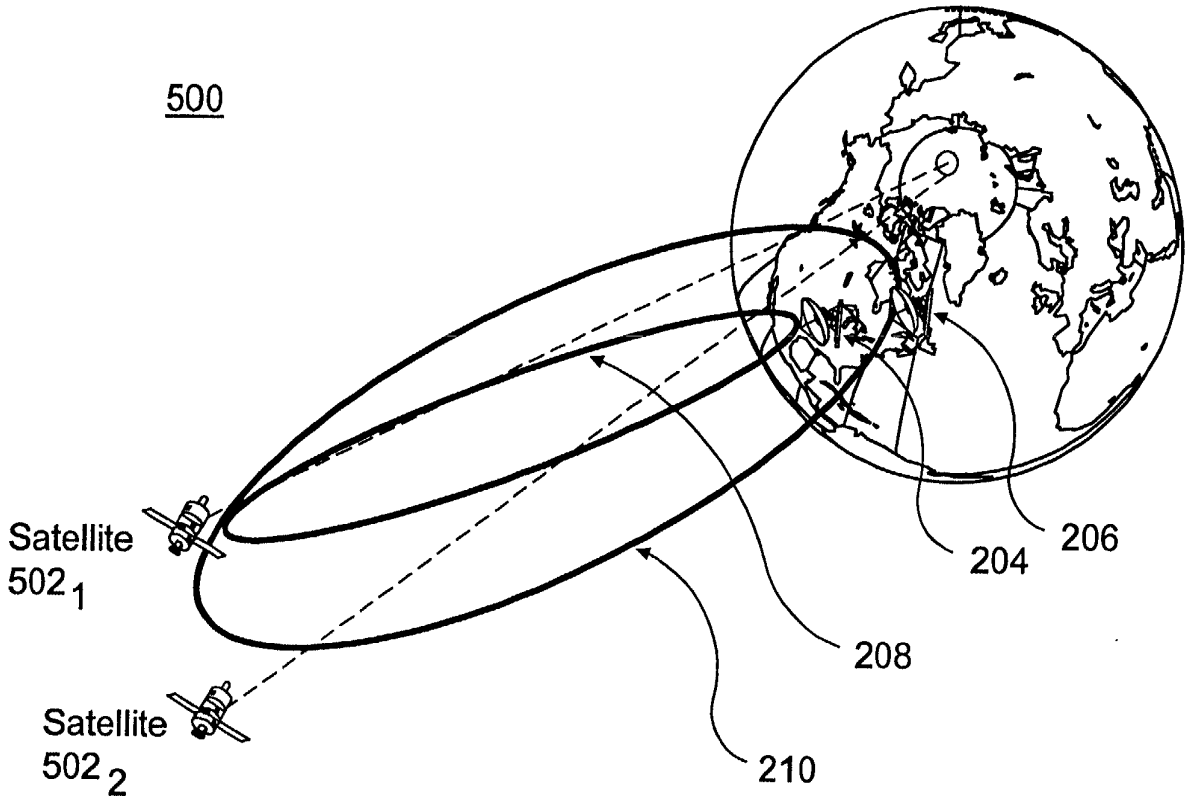

FIG. 5

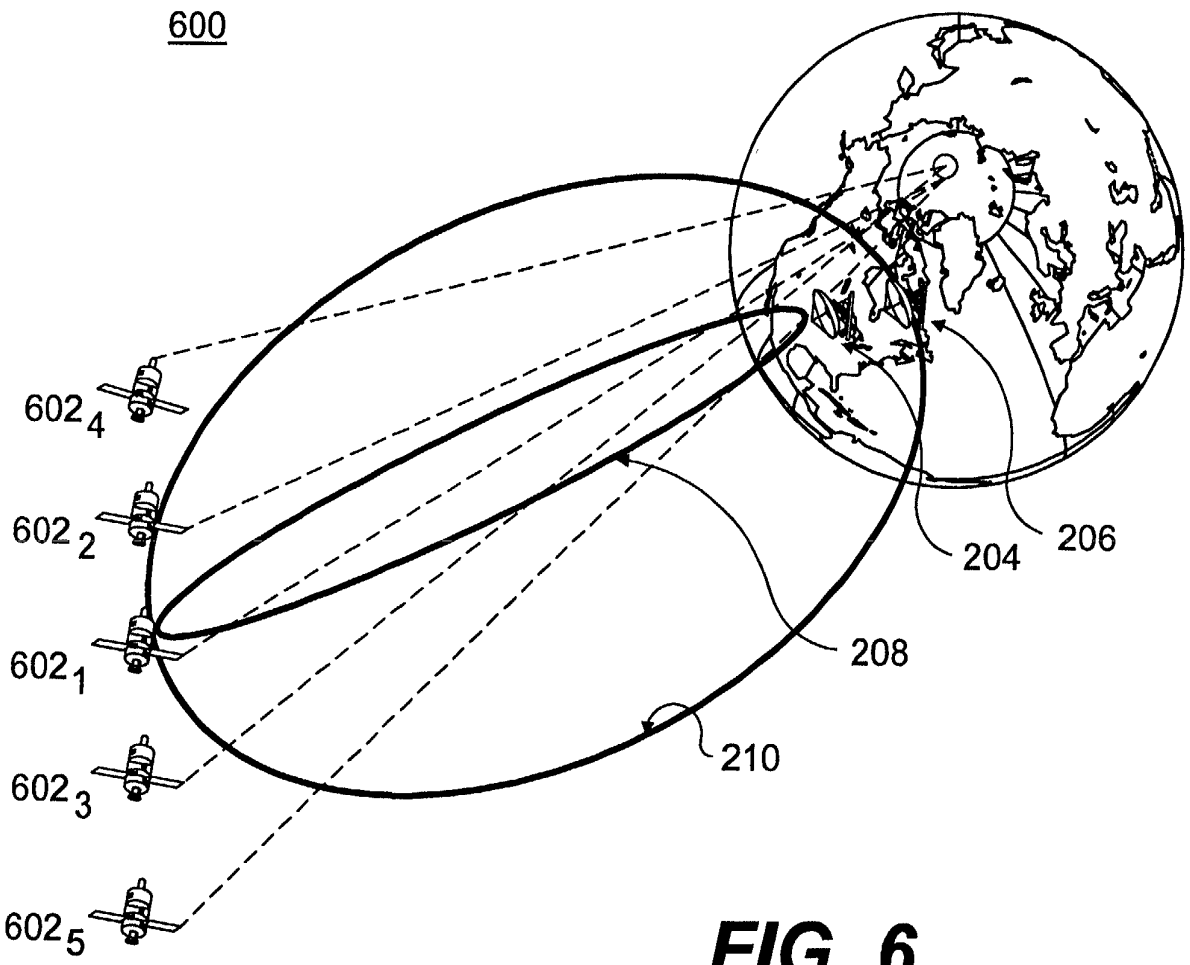

FIG. 6

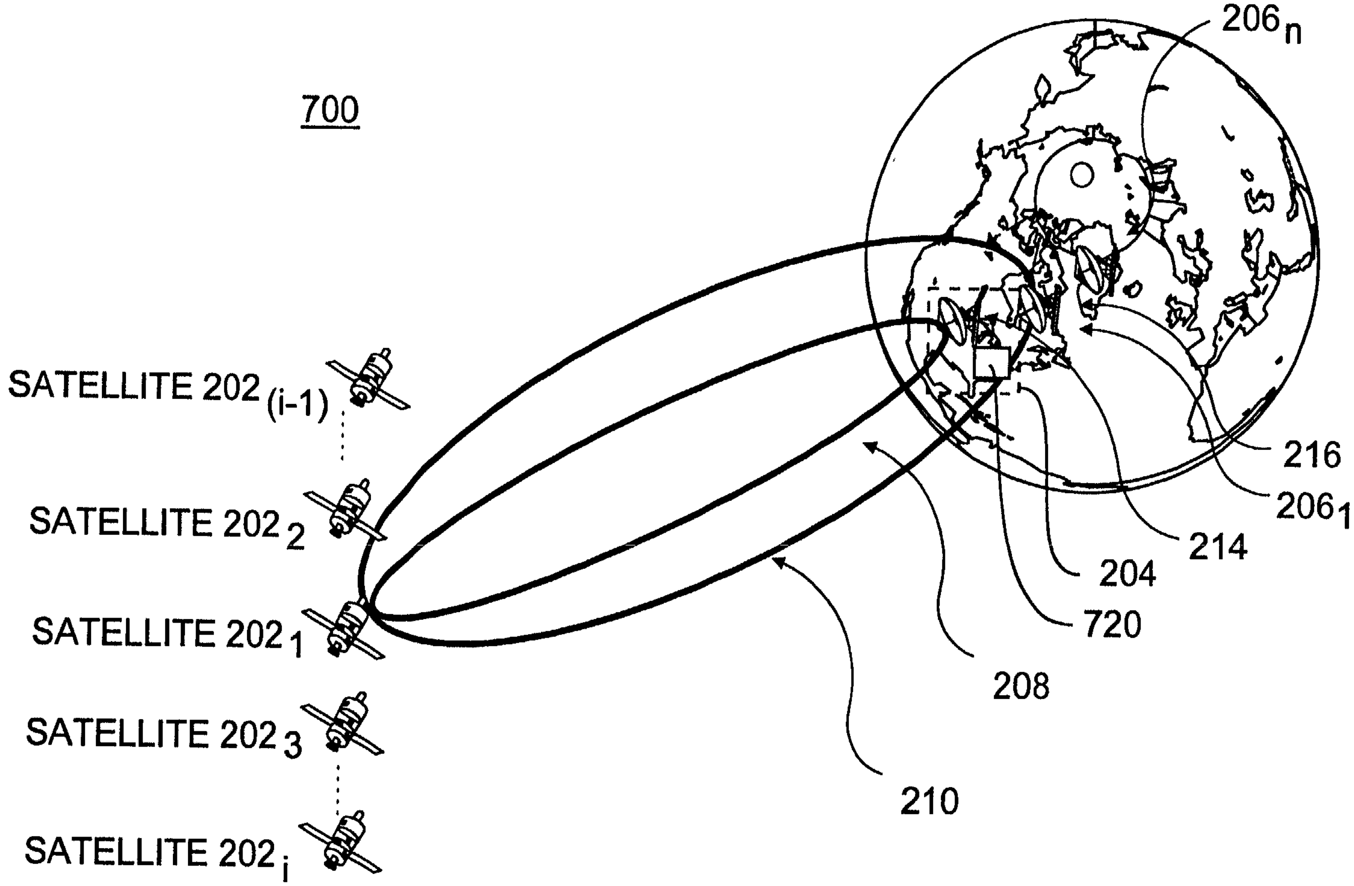

FIG. 7

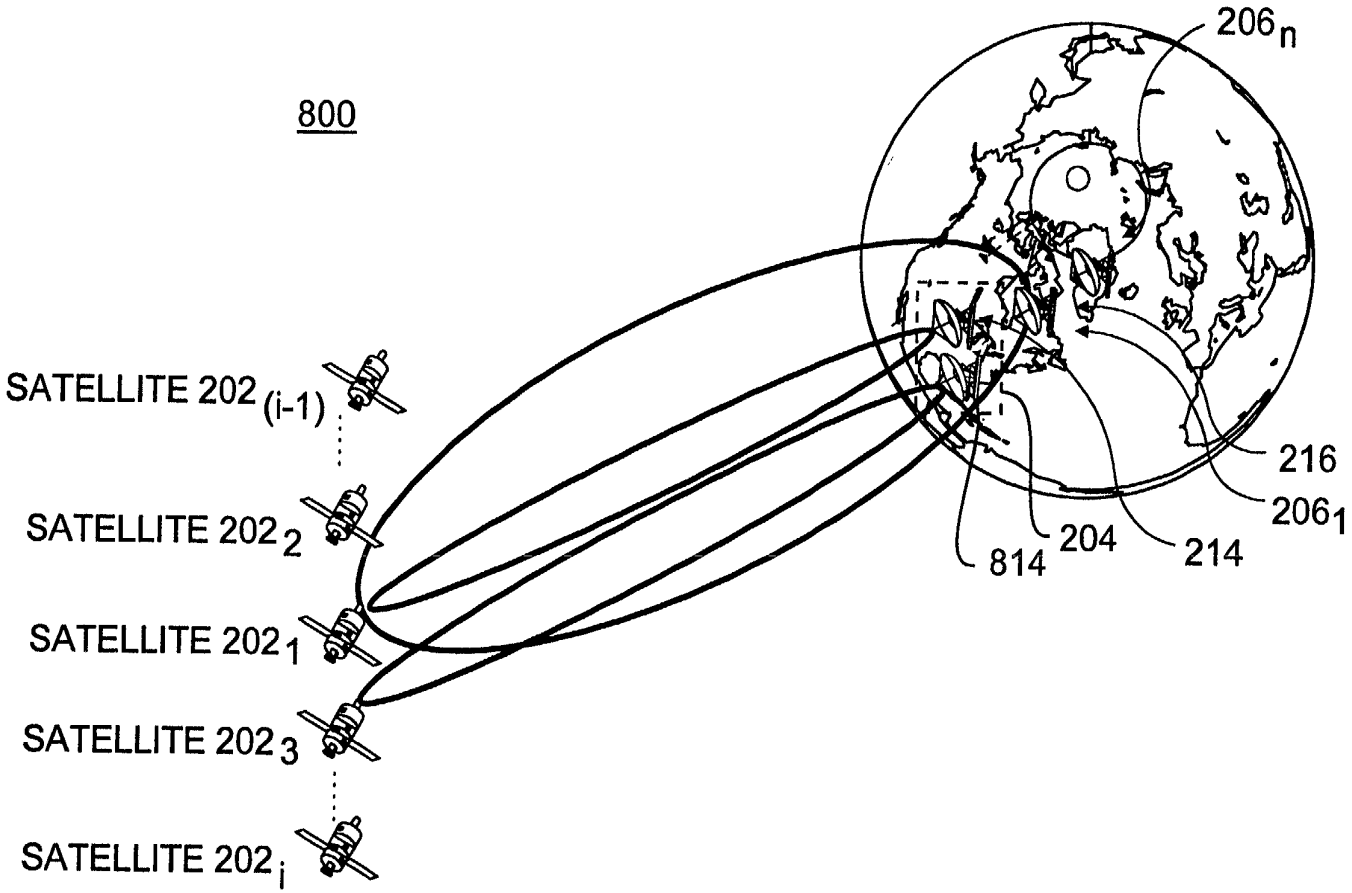
800
206n
SATELLITE 202(i-1)
SATELLITE 2022
SATELLITE 2021
SATELLITE 2023
SATELLITE 202i
216
2061
204
214
814

FIG. 8

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

Attorney Docket No. **97-904CIP1**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND SYSTEM FOR PREVENTING SUN TRANSIT OUTAGES IN POINT-TO-MULTIPOINT SATELLITE SYSTEMS

the specification of which (check one) [**x**] is attached hereto. [ ] was filed on
as Appln. Serial No. and was amended on
(if applicable). I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
(Number)	(Country)	(Day/Month/Year filed)	[_] Yes [_] No

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date for this application:

(Appln. Serial No.)	(Filing Date)	(Status--patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Leonard C. Suchyta, Reg. No. 25,707 and Floyd E. Anderson, Reg. No. 33,825

Attorney Docket No. **97-904CIP1**

Address all telephone calls to **Floyd E. Anderson** at telephone no. **(781) 466-4016**

Address all correspondence to **Leonard C. Suchyta**
GTE Service Corporation
600 Hidden Ridge, HQE03G13
Irving, TX 75038

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE OR FIRST INVENTOR **Richard H. Warren**

Inventor's signature _____ Date _____

Residence **Rockville, Maryland** Citizenship **US**

Post Office Address **7025 Wick Lane, Rockville, MD 20855**